

# XIV. NERVOUS SYSTEM

## PNS: SENSORY RECEPTORS

154  
See 11, 139, 161

CN: Use your lightest colors for A and E. (1) Begin with the overview of a sensory pathway. (2) Color the general exteroceptors. Note that each receptor is connected to sensory neuron (B) of a different color. (3) Color the proprioceptors in the lower illustration. Color over the entire muscle spindle, but not the surrounding muscle fibers.

Sensory receptors provide information to the brain about the internal and external environment of the body. Most receptors are transducers: they convert mechanical, chemical, electrical or light stimuli to electrochemical impulses that can be conducted by the nervous system. Once generated, informational or sensory impulses travel to the CNS via sensory neurons, ultimately reaching the thalamus. Here impulses are relayed to the sensory cortex (conscious interpretation) or to motor centers for appropriate (reflexive) response.

### EXTEROCEPTORS: A

SPECIAL: A<sup>1</sup> - N<sup>5</sup>

GENERAL: A

TOUCH/TACTILE R. A<sup>1</sup>

THERMORECEPTOR A<sup>2</sup>

MEISSNER'S ENDING A<sup>3</sup>

FREE NERVE ENDING A<sup>4</sup>

Exteroceptors are located near the body surface. Special exteroceptors (not shown here) include the photoreceptors of the retina (light stimuli), taste receptors (chemical stimuli), and auditory receptors (sound stimuli). General exteroceptors include free nerve endings and encapsulated endings sensitive to touch, temperature change, and pain at the body surface. *Touch receptors* include those that encircle hair follicles and hair shafts, and tactile discs (of Merkel) below the epidermis. Touch-sensitive *Meissner's endings* (corpuscles) occur mainly in thick skin without hair, fitting in the cones of dermal papillae. *Thermoreceptors* (sensitive to temperature change) may be free endings or encapsulated bodies. *Free nerve endings* in the skin can be found in and deep to the epidermis. They may be sensitive to touch, heat, cold, and/or pain (nociception). Free nerve endings sensitive to a number of different stimuli are called polymodal receptors (sensitive to more than one kind of stimulus).

### PROPRIOCEPTORS: E

PACINIAN CORPUSCLE E<sup>1</sup>

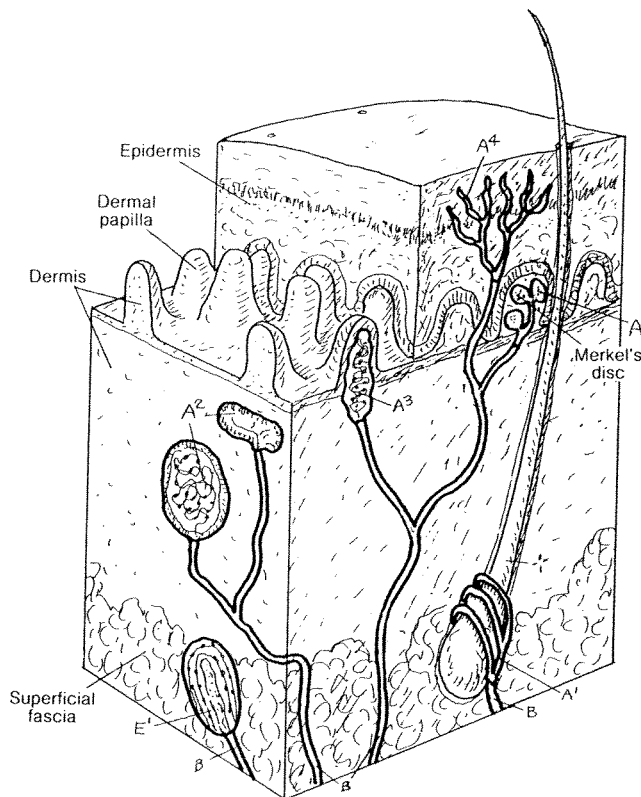
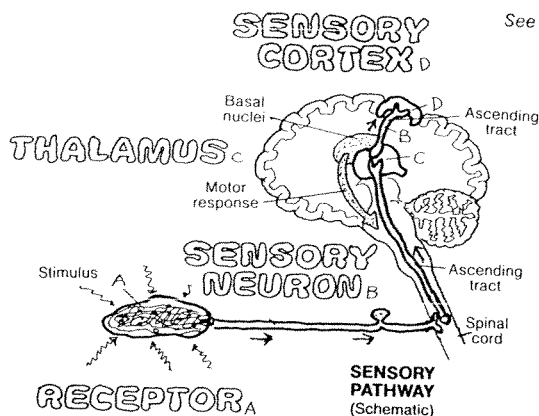
MUSCLE SPINDLE E<sup>2</sup>

NEUROTENDINOUS ORGAN E<sup>3</sup>

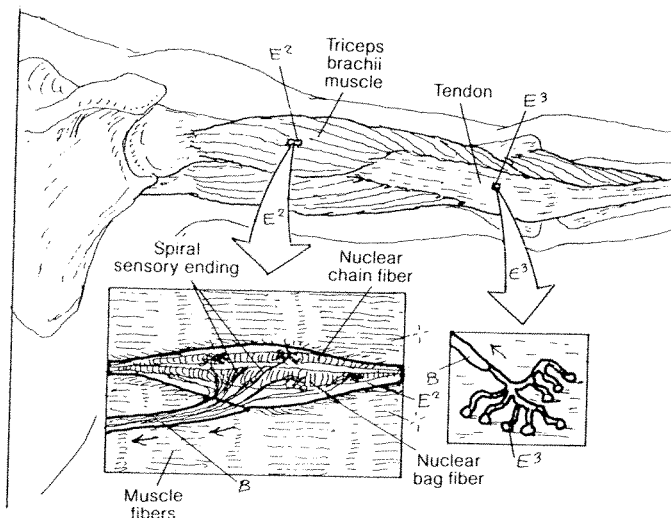
Proprioceptors are found in deeper tissues (superficial fascia, deep fascia, tendons, ligaments, muscles, joint capsules, and so on) of the musculoskeletal system. They are sensitive to stretch, movement, pressure, and changes in position. The *Pacinian corpuscles* are large lamellar bodies acting as mechanoreceptors: distortion of their onion skin-like lamellae induces generation of an electrochemical impulse. *Muscle spindles*, sensitive to stretch, consist of two types of special muscle fibers (nuclear bag and nuclear chain) entwined with spiral or flower-spray sensory endings. Stretch of these spindles (and the skeletal muscle in which they are located) induces discharge in the sensory fibers. These impulses reach the cerebellum. Reflexive motor commands tighten the special muscle fibers and increase resistance of the skeletal muscle to stretch. By these spindles, the CNS controls muscle tone and muscle contraction. *Neurotendinous organs* (Golgi) are nerve endings enclosed in capsules located at muscle/tendon junctions or in tendons. They are induced to generate electrochemical impulses in response to tendon deformation or stretch.

### INTEROCEPTORS: I - N<sup>5</sup>

Interoceptors (not shown) are free or encapsulated nerve endings, often in association with special epithelial cells, located in the walls of vessels and viscera. These receptors include chemoreceptors, baroreceptors (pressure), and nociceptors. They generally are not sensitive to the same stimuli to which exteroceptors react.



EXTEROCEPTORS  
IN THE SKIN



PROPRIOCEPTORS  
IN DEEP TISSUE